

BYiYghY'?fmdhc!5bghY``ib[.'@YX[Yf9bhYfdf]gY'\Uh'Y]bYb'bYiYb'5bZØ\fYf

9]b'k Y]hYfYf'Y\Ya U`][Yf'6`cW!A UbU[Yf'hfUh'XYa '?fmdhc! $NU^i b[gi bhYfbY^a Yb^A cV]^Y7c]b^VY]^9]b^Y^Ya U^][Yf^7]h]!$ A UbU[Yf'k i fXY'Ub[YnUdZhži a 'XUg'K UW\ghi a 'XYf Dfcj YbUbWY '6 `cW_WXU]b 'ni '`Y]hYb '< Ui dhVi WX '[YbUbbh'5 `YI N]bXYf'U`g'J]nYdfÀg]XYbh'XYf'@YX[Yf'9bhYfdf]gY!@Ògi b[YbXU XYfJcfghUbX'Ui WX XYa JcfghUbX'XYg'l bhYfbY\a Ybg VY]hfYhYb k]fX" N]b XYf gWX `c gg 'g]WX 'Ub Ui dhVi WXi bhYfbY\a Yb^]a ^A Àfn^&\$&%^bUWX^ZUgh^nk Y] \U\fnY\bhYb']b'XYf'?Ud]hU`a Uf_hhYW\bc`c[]Y"'Ni j cf UfVY]hYhY'Yf'VY]'BUgXUe'U`g'8]fY_hcf'ZØf'[`cVU`Y GcZhk UfYYbhk]W_`ib['ibX'ghY``jYfhfYhYbXYf'J]nYdfÀg]XYbh ZØf'I bhYfbY\a YbqUfWX]hY_hi ffc``Yb"'N]bXYf'k]fX'@YX[Yf $9bhYfdf]qY = bhYfUWh Y hYb ZY bYi Y bYi Y b [Y ZØ \ fhY F Y] \ Y i cb$ @Òqi b[Ybž'X]Y'Yg'?i bXYb'Yfa Ò[`]WXYbž' ⇒bhYfU_h]cbYb']b Ga Ufh!7cbhfUWh!ZÀ\][Yb Dfchc_c``Yb ni 'j Yfk U`hYbž'X]Y GhU_]b[žb]WXhZi b[]V`Y Hc_Yb fB: HgŁi bX UbXYfY / Ua d/Y``]d/

- 9]b'k Y]hYfYf'Y\Ya U`][Yf'6`cW_!A UbU[Yf'hfUh'XYa '?fmdhc! NU\`i b[gi bhYfbY\a Yb'A cV]`Y7c]b'VY]
- 9]b'Y\Ya U`][Yf'7]h]!A UbU[Yf'k i fXY'Ub[YnUdZhž'i a 'XUg K UW\qhi a 'XYf'DfcjYbUbW'6`cW_W\U]b'ni '`Y]hYb

< Ui dhVi WX '[YbUbbh'5`YI 'N]bXYf'U`g'J]nYdfÀg]XYbh'XYf'@YX[Yf
9bhYfdf]gY!@Ògi b[YbXU'XYf'JcfghUbX'Ui WX'XYa 'JcfghUbX'XYg
I bhYfbY\a Ybg'VY]hfYhYb'k]fX"</pre>

N]bXYf`gWX`cgg`g]WX`Ub`< Ui dhVi WX i bhYfbY\a Yb`]a `A Àfn`&\$&% bUWX`ZUgh`nk Y]`\J\fnY\bhYb`]b`XYf`? Ud]hU`a Uf_hhYWXbc`c[]Y"
Ni j cf`UfVY]hYhY`Yf`VY]`BUgXUe`U`g`8]fY_hcf`ZØf`[`cVU`Y
GcZhk UfYYbhk]W_`i b[`i bX`ghY``j YfhfYhYbXYf`J]nYdfÀg]XYbh`ZØf I bhYfbY\a YbgUfWX]hY_hi ffc``Yb"

 $\label{eq:normalized_normalized_normalized} $$N]bXYf'k]fX'@YX[Yf'9bhYfdf]gY' $$bhYfUWh'`Y]hYbZ'Y]bY'bYi $$Y]bY'BYi $$Y]bY'FY]\Y'j cb'@Ògi b[YbZ'X]Y'Yg'?i bXYb'Yfa Ò[`]WXYbZ $$bhYfU_h]cbYb']b'Ga Ufh!7cbhfUWh!Z\\][Yb'Dfchc_c``Yb'ni jYfk U`hYbZ'X]Y'GhU_]b[Z'b]W\h'Zi b[]V`Y'Hc_Yb'fB: HgŁ'i bX'UbXYfY $$XYnYbhfU`Y':]bUbna Ò[`]W_Y]hYb'fBY:]Ł'i bhYfghØhnYb'' $$$

? ca dUgg `A]b]b[`[Ya]YhYh \approx X]Y `:]gWX Yf `U`g `7 \]Y Z`:]bUbW]U` C ZZ]WYf `i b X `F c `G\]fc `Y `U`g `7 \]Y Z'; fck h\ `C ZZ]WYf `U`g `C b`]bY! A Uf_hd`Uhn `ZØf `6]hWc]b!A]b]b[! < UfXk UfY \check{z} < cgh]b[`i b X K Y]hYfj Yf_Ui Z'j Yfgi WXh \check{z} 'gY]b `K UWX ghi a `ni `fUh]cbU`]g]YfYb"

:]g\Yf'\Uh'k À\fYbX']\fYf'NY]h'U`g'7: C'a Y\fYfYf HYW\bc`c[]Yi bhYfbY\a Yb']b'XYf': fØ\d\UgY'i bX'U`g'7cbhfc``Yf]b VY]'=6A'I bhYfbY\a Yb'Xi fW\GYYX!Fi bXYbž'Df]j UhY!9ei]hm! :]bUbn]Yfi b[Ybž'9I]h!GhfUhY[]Yb'i bX'6ÒfqYb[Àb[Y'[YZØ\fh"

VY]a = ZfUghfi _hi fi bhYfbY\a Yb ZØf X][]hU`Y K À\fi b[Yb 7ca di hY Bcfh\ k Ufž k]fX g]W XUfUi Z _cbnYbhf]YfYbž X]Y FY]W k Y]hY j cb 7ca dUgg j cb XYf 6YhfYi i b['j cb 'Df]j Uh_i bXYb Ui Z X]Y 6YhfYi i b['j cb ': cbXgž : Ua]`m C ZZ]W g i bX]bgh]hi h]cbY `Yb '? i bXYb ni 'Yfk Y]hYfb"

?fmdhc!NU\`i b[gi bhYfbY\a Yb'A cV]`Y7c]b'\]bni [Y \mathbb{Z} 0[h'5`UbDUi `]b'U`g'J]\\TofYg]\XYbh'c\\Z'9b[]b\YYf]b["'DUi `]b'_ca a h'j cb 6`c_'f\\TofY\\Yf'Gei UfY\\\Z'k c'\Yf'h\Y\\\b]g\\X\Yf'\@\Yf\\K\Uf\''

DUi `]b `\ Uh`Ui W\ `U`g`GYb]cf`8 Yj Y`cda Ybh'@YUX`VY]`A]WfcgcZh [YUfVY]hYhž'k c`Yf`Ub`XYf`9bhk]W_`i b['j cb'J]fhi U``9Ufh\ a]h[Yk]f_h'\ Uhž'i bX'k Uf`gdÀhYf`GYb]cf`GcZhk UfY`9b[]bYYf`VY]; cc[`Y"

9f'k]fX'XYf'nk Y]hY'Y\Ya U`][Y'A]hUfVY]hYf'j cb'6`c W_{z} 'XYf'ni A cV]`Y7c]b'_ca a hz'XU'6cV'@YYz'XYf'j cb'&\$%\$'V]g'&\$%('7\]YZ HYW\bc`c[m'C\Z]\Wf'j cb'6`c\W_'k Ufz']a '8YnYa VYf'7\]YZ'DfcXi Wh C\Z]\Wf'XYg'?fmdhc[Yg\W\\A\Z\ng'k i fXY''

8]Y'Dfcj YbUbW'6'cW_W U]b': ci bXUh]cb'VYbUbbhYf
Y\Ya U`][Yf'7]h]!A UbU[Yf'A cf[Ub'A W? YbbYm'U`g'XYggYb'79C"
G]Y'k]fX'j Yfgi W\Ybž'a]h:]bUbn]bgh]hi hYbž':]bhYW\g'i bX
9bhk]W_`Yfb'ni gUa a Ybni UfVY]hYbž'i a 'X]Y'9]bZØ\fi b['XYf
ÒZZYbh`]W\Yb'CdYb!Gci fWY!6`cW_W\U]b'j cfUbni hfY]VYbž'X]Y'gdYn]Y``
ZØf'X]Y':]bUbnX]Ybgh`Y]ghi b[gVfUbW\Y'Ybhk]W_Y`h'k i fXY"

? fmd hc!D`UhhZcfa $: 8 YgWfmd hc! 6 YghAb X Y Zf\emptyset \ Yf'VY_Ubbh'U`g'K$ HY W\\ bc`c[]Yg\`Z'Y]b[YghY``h'\ 7 fYYbU[\':\`mbb'U`g'\ 7\]YZ'A\ Uf_Yh]b[C\ ZZ|W\Yf''\]

@Ui h']\fYf'@|b_YX±b!GY]hY'k Uf': `mbb'ni `Yhnh'?fYUh]j X]fY_hcf]b'ZØf XUg'6YfUhi b[g!'i bX']bhYfbUh]cbU`Y'6Yn]Y\i b[gi bhYfbY\a Yb A]X5h`Ubh]W7Ud]hU``A UbU[Ya Ybh'i bX'79C'XYg'I bhYfbY\a Ybg'ZØf; YgW\ÀZhgYbhk]W_`i b[g`Ògi b[Yb'7fUj Y'; Yb]i g''

6]hWc]b!A]bYf'HYfUK i `Z'YfbUbbh'A]WXUY`'6i WY``U'i bX'?Yff] @Ub[`U]g'Ub'gY]bYb'JcfghUbXž'XU'g]WX'XUg'I bhYfbY\a Yb'Ui Z'XYb 5i ZVUi 'Y]bYg'ni '%\$\$'i '_c\`YbghcZZZfY]Yb'9bYf[]YbYhnYg _cbnYbhf]Yfh"

6i WY``U']gh'DUfhbYf'i bX'[`cVU`Yf'@Y]hYf'ZØf'ghfUhY[]gW.Y

DUfhbYfgW.UZhYb'i bX'; YgW.ÀZhgYbhk]W_`i b['VY]'XYf'?fmdhc!

#bj Ygha YbhZ]fa U'6`cW_Hck Yf'7Ud]hU`"'Ni j cf'j YfVfUW.hY'Yf'ZUgh
Y]b'*J\fnY\bh'VY]'; c`Xa Ub'GUW.gž'k c'Yf'XUg'A i `h]!5ggYh!

J Yf_Ui Zg!'i bX'<UbXY`g[YgW.ÀZh']b'?UbUXU'`Y]hYhY"

@Ub[`U]g']gh'7\]YZ'GhfUhY[m'CZZ]WYf'jcb'HYfUKi`Z'ibX jYfUbhkcfh`]W\'ZØf'X]Y'U``[YaY]bY'IbhYfbY\aYbgghfUhY[]Yž;YgW\ÀZhgYbhk]W_`ib[ž'ghfUhY[]gW\Y'DUfhbYfgW\UZhYb'ibX KUW\ghiag]b]h]Uh]jYb"

п • п

 $H\Y`dcgh`@UhYgh`]b`7fmdhc`<]f]b[.`@YX[Yf`9bhYfdf]gY`\Ug`BYk @YUXYf`]gh`_Y]bY`Z]bUbn]Y``Y`6YfUhi b["$

8 YhU]`a

6Ygi WXYb G]Y i bg Ui Z _fmdhc!bYk g"Uh